

What is claimed is:

1. A composition for use in photo-fabrication of objects comprising:

- (a) an oxetane;
- (b) an epoxy compound selected from the group consisting of glycidyl esters of fatty acids, epoxidated soybean oil, and epoxidated linseed oil; and
- (c) a cationic photoinitiator;

wherein an H-shaped object obtained by curing said composition has a dimensional accuracy value of less than or equal to 0.10 mm.

2. The composition of claim 1, comprising a further epoxy compound, said further epoxy compound being present, relative to the total composition, in an amount of 3-50 wt %.

3. The composition of claim 1, wherein said composition has substantially the same Young's Modulus when cured at an irradiation dose of 100 mJ/cm² as at an irradiation dose of 500 mJ/cm².

4. The composition of claim 2, wherein said further epoxy compound has a molecular weight of more than 1,000.

5. The composition of claim 1, wherein said epoxy compound has a molecular weight of less than 1,000.

6. A three-dimensional object comprising a cured photo-curable resin composition according to claim 1.

7. A process for photo-fabricating a three-dimensional object comprising selectively curing the photo-curable resin composition of claim 1.

8. A process for photo-fabricating a three-dimensional object comprising selectively curing a photo-curable resin composition comprising:

- (a) an oxetane;
- (b) an epoxy compound; and

(c) a cationic photoinitiator,

wherein said process comprises

(i) forming a layer of said composition;

(ii) selectively irradiating said layer of said composition to form a solid cured resin layer;

(iii) forming a layer of said composition on the solid cured resin layer; and

(iv) repeating steps (ii) and (iii).

9. The process of claim 8, wherein said composition comprises 3-50 wt %, relative to the total weight of the composition, of said epoxy compound.

10. The process of claim 8, wherein an H-shaped object obtained by curing said composition has a dimensional accuracy value of less than or equal to 0.10 mm.

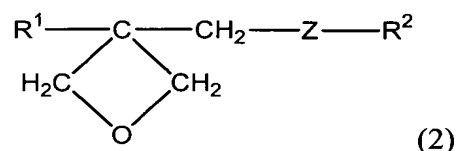
11. A three-dimensional object obtained by the process of claim 8.

12. A three-dimensional object obtained by the process of claim 9.

13. A three-dimensional object obtained by the process of claim 10.

[14. A three-dimensional object obtained by the process of claim 11.]

15. The process of claim 8, wherein said oxetane is selected from the group consisting of oxetanes represented by the following formula (2)



wherein

Z represents sulfur or oxygen;

R¹ represents a hydrogen atom; a fluorine atom; an alkyl group having from 1 to 6 carbon atoms; a fluoroalkyl group having from 1 to 6 carbon atoms; an aryl group having from 6 to 18 carbon atoms; a furyl group; or a thienyl group; and

R² represents a hydrogen atom; an alkyl group having from 1 to 6 carbon atoms; an alkenyl group having from 2 to 6 carbon atoms; an aryl group having from 6 to 18 carbon atoms; an aralkyl group having from 7 to 18 carbon atoms; an aralkyloxy group; an alkylcarbonyl group having from 2 to 6 carbon atoms; an alkoxycarbonyl group having from 2 to 6 carbon atoms; or an N-alkylcarbamoyl group having from 2 to 6 carbon atoms.

16. The process of claim 15, wherein R¹ represents an alkyl group having from 1 to 6 carbon atoms.

17. The process of claim 15, wherein R¹ represents methyl or ethyl.

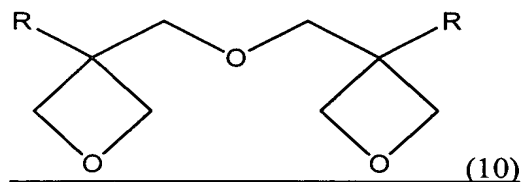
18. The process of claim 15, wherein R² represents hydrogen; an alkyl group having from 1 to 6 carbon atoms; or an aryl group.

19. The process of claim 16, wherein R² represents hydrogen; an alkyl group having from 1 to 6 carbon atoms; or an aryl group.

20. The process of claim 17, wherein R² represents hydrogen, methyl, ethyl, or phenyl.

21. The process of claim 8, wherein said oxetane has two or more oxetane rings.

22. The process of claim 8, wherein said oxetane is represented by the following formula (10):



wherein R represents a hydrogen atom; a fluorine atom; an alkyl group having from 1 to 6 carbon atoms; a fluoroalkyl group having from 1 to 6 carbon atoms; an aryl group having from 6 to 18 carbon atoms; a furyl group; or a thienyl group.

23. The process of claim 22, wherein each R represents an alkyl group having from 1 to 6 carbon atoms.

24. The process of claim 22, wherein each R represents an ethyl group.

25. The process of claim 8, wherein said oxetane has 3 or more oxetane rings.

26. The process of claim 8, wherein said oxetane is selected from the group consisting of 3-ethyl-3-hydroxymethyloxetane, 3-(meth)-allyloxymethyl-3-ethyloxetane, (3-ethyl-3-oxetanylmethoxy)methylbenzene, 4-fluoro-[1-(3-ethyl-3-oxetanylmethoxy)methyl]benzene, 4-methoxy-[1-(3-ethyl-3-oxetanylmethoxy)methyl]-benzene, [1-(3-ethyl-3-oxetanylmethoxy)ethyl]phenyl ether, isobutoxymethyl(3-ethyl-3-oxetanylmethyl) ether, isobornyloxyethyl(3-ethyl-3-oxetanylmethyl) ether, isobornyl(3-ethyl-3-oxetanylmethyl) ether, 2-ethylhexyl(3-ethyl-3-oxetanylmethyl) ether, ethyldiethylene glycol (3-ethyl-3-oxetanylmethyl) ether, dicyclopentadiene (3-ethyl-3-oxetanylmethyl) ether, dicyclopentenyl(3-ethyl-3-oxetanylmethyl) ether, tetrahydrofurfuryl(3-ethyl-3-oxetanylmethyl) ether, tetrabromophenyl(3-ethyl-3-oxetanylmethyl) ether, 2-tetrabromophenoxyethyl(3-ethyl-3-oxetanylmethyl) ether, tribromophenyl(3-ethyl-3-oxetanylmethyl) ether, 2-tribromophenoxyethyl(3-ethyl-3-oxetanylmethyl) ether, 2-hydroxyethyl(3-ethyl-3-oxetanylmethyl) ether, 2-hydroxypropyl(3-ethyl-3-oxetanylmethyl) ether, butoxyethyl (3-ethyl-3-oxetanylmethyl) ether, pentachlorophenyl(3-ethyl-3-oxetanylmethyl) ether, pentabromophenyl(3-ethyl-3-oxetanylmethyl) ether, bornyl(3-ethyl-3-oxetanylmethyl) ether, 3,7-bis(3-oxetanyl)-5-oxa-nonane, 3,3'-(1,3-(2-methylenyl)propanediylbis-(oxymethylene))-bis-(3-ethyloxetane), 1,4-bis[(3-ethyl-3-oxetanylmethoxy)methyl]benzene, 1,2-bis[(3-ethyl-3-oxetanylmethoxy)methyl]ethane, 1,3-bis[(3-ethyl-3-oxetanylmethoxy)methyl]propane, ethylene glycol bis(3-ethyl-3-oxetanylmethyl) ether, dicyclopentenylbis(3-ethyl-3-oxetanylmethyl) ether, triethylene glycol bis(3-ethyl-3-oxetanylmethyl) ether, tetraethylene glycol bis(3-ethyl-3-oxetanylmethyl) ether, tricyclodecanediyl dimethylene bis(3-ethyl-3-oxetanylmethyl) ether, trimethylolpropane tris(3-ethyl-3-oxetanylmethyl) ether, 1,4-bis(3-ethyl-3-oxetanylmethyl)butane, 1,6-bis(3-ethyl-3-oxetanylmethoxy)hexane, pentaerythritol tris(3-ethyl-3-oxetanylmethyl) ether, pentaerythritol tetrakis(3-ethyl-3-oxetanylmethyl) ether, polyethylene glycol bis(3-ethyl-3-oxetanylmethyl) ether, dipentaerythritol hexakis(3-ethyl-3-oxetanylmethyl) ether, dipentaerythritol pentakis(3-ethyl-3-oxetanylmethyl) ether, dipentaerythritol tetrakis(3-ethyl-3-oxetanylmethyl) ether, caprolactone modified dipentaerythritol hexakis(3-ethyl-3-oxetanylmethyl) ether, caprolactone modified

dipentaerythritol pentakis(3-ethyl-3-oxetanylmethyl) ether, ditrimethylolpropane tetrakis(3-ethyl-3-oxetanylmethyl) ether, EO modified bisphenol A bis(3-ethyl-3-oxetanylmethyl) ether, PO modified bisphenol A bis(3-ethyl-3-oxetanylmethyl) ether, EO modified hydrogenated bisphenol A bis(3-ethyl-3-oxetanylmethyl) ether, PO modified hydrogenated bis(3-ethyl-3-oxetanylmethyl) ether, and EO modified bisphenol F bis(3-ethyl-3-oxetanylmethyl) ether.

27. The process of claim 8, wherein said epoxy compound has a number average molecular weight of 1,000-20,000.

28. The process of claim 15, wherein said epoxy compound has a number average molecular weight of 1,000-20,000.

29. The process of claim 21, wherein said epoxy compound has a number average molecular weight of 1,000-20,000.

30. The process of claim 8, wherein said epoxy compound has a molecular weight of less than about 1,000.

31. The process of claim 15, wherein said epoxy compound has a molecular weight of less than about 1,000.

32. The process of claim 21, wherein said epoxy compound has a molecular weight of less than about 1,000.

33. The process of claim 8, wherein said epoxy compound is an alicyclic epoxy compound.

34. The process of claim 15, wherein said epoxy compound is an alicyclic epoxy compound.

35. The process of claim 21, wherein said epoxy compound is an alicyclic epoxy compound.

36. The process of claim 8, wherein said composition further comprises a polyol.

37. The process of claim 15, wherein said composition further comprises a polyol.

38. The process of claim 21, wherein said composition further comprises a polyol.

39. The process of claim 8, wherein said composition further comprises a monomer having more than two ethylenically unsaturated bonds.

40. The process of claim 15, wherein said composition further comprises a monomer having more than two ethylenically unsaturated bonds.

41. The process of claim 21, wherein said composition further comprises a monomer having more than two ethylenically unsaturated bonds.

42. The process of claim 8, wherein said composition comprises dipentaerythritol penta(meth)acrylate and/or dipentaerythritol hexa(meth)acrylate.

43. The process of claim 15, wherein said composition comprises dipentaerythritol penta(meth)acrylate and/or dipentaerythritol hexa(meth)acrylate.

44. The process of claim 21, wherein said composition comprises dipentaerythritol penta(meth)acrylate and/or dipentaerythritol hexa(meth)acrylate.

45. The process of claim 8, wherein said composition has substantially the same Young's Modulus when cured at an irradiation dose of 100 mJ/cm² as at an irradiation dose of 500 mJ/cm².

46. The process of claim 15, wherein said composition has substantially the same Young's Modulus when cured at an irradiation dose of 100 mJ/cm² as at an irradiation dose of 500 mJ/cm².

47. The process of claim 21, wherein said composition has substantially the same Young's Modulus when cured at an irradiation dose of 100 mJ/cm² as at an irradiation dose of 500 mJ/cm².

48. The process of claim 8, wherein the Young's Modulus of said composition when cured at an irradiation dose of 100 mJ/cm² differs less than 25 kg/mm² from the Young's Modulus of said composition when cured at an irradiation dose of 500 mJ/cm².

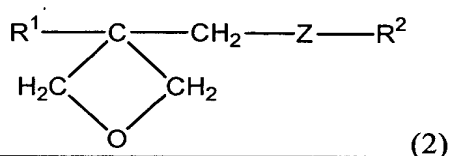
49. The process of claim 15, wherein the Young's Modulus of said composition when cured at an irradiation dose of 100 mJ/cm² differs less than 25 kg/mm² from the Young's Modulus of said composition when cured at an irradiation dose of 500 mJ/cm².

50. The process of claim 21, wherein the Young's Modulus of said composition when cured at an irradiation dose of 100 mJ/cm² differs less than 25 kg/mm² from the Young's Modulus of said composition when cured at an irradiation dose of 500 mJ/cm².

51. A composition comprising:

(i) an oxetane selected from the group consisting of

(a) oxetanes represented by the following formula (2)



wherein

Z represents sulfur or oxygen;

R¹ represents a hydrogen atom; a fluorine atom; an alkyl group having from 1 to 6 carbon atoms; a fluoroalkyl group having from 1 to 6 carbon atoms; an aryl group having from 6 to 18 carbon atoms; a furyl group; or a thienyl group;
and

R² represents a hydrogen atom; an alkyl group having from 1 to 6 carbon atoms; an alkenyl group having from 2 to 6 carbon atoms; an aryl group having from 6 to 18 carbon atoms; an aralkyl group having from 7 to 18 carbon atoms; an aralkyloxy group; an alkylcarbonyl group having from 2 to 6 carbon atoms; an alkoxycarbonyl group having from 2 to 6 carbon atoms; or an N-alkylcarbamoyl group having from 2 to 6 carbon atoms; and

(b) oxetanes comprising two or more oxetane rings;

- (ii) an epoxy compound;
- (iii) a cationic photoinitiator; and
- (iv) a polyfunctional monomer selected from the group consisting of penta(meth)acrylates and hexa(meth)acrylates.

52. The composition of claim 51, wherein said oxetane is represented by said formula (2).

53. The composition of claim 52, wherein

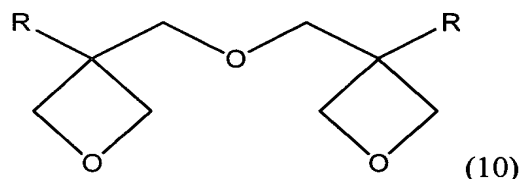
Z represents oxygen,

R¹ represents an alkyl group having from 1 to 6 carbon atoms, and

R² represents hydrogen, an alkyl group having from 1 to 6 carbon atoms, or an aryl group.

54. The composition of claim 51, wherein said oxetane has 2 or more oxetane rings.

55. The composition of claim 54, wherein said oxetane is represented by the following formula 10:



wherein R represents a hydrogen atom; a fluorine atom; an alkyl group having from 1 to 6 carbon atoms; a fluoroalkyl group having from 1 to 6 carbon atoms; an aryl group having from 6 to 18 carbon atoms; a furyl group; or a thienyl group.

56. The composition of claim 55, wherein each R represents an alkyl group having from 1 to 6 carbon atoms.

57. The composition of claim 55, wherein each R represents an ethyl group.

58. The composition of claim 51, wherein said oxetane has 3 or more oxetane rings.

59. The composition of claim 51, wherein said composition comprises dipentaerythritol penta(meth)acrylate and/or dipentaerythritol hexa(meth)acrylate.

60. The composition of claim 51, wherein said composition has substantially the same Young's Modulus when cured at an irradiation dose of 100 mJ/cm² as at an irradiation dose of 500 mJ/cm².

61. The composition of claim 51, wherein the Young's Modulus of said composition when cured at an irradiation dose of 100 mJ/cm² differs less than 25 kg/mm² from the Young's Modulus of said composition when cured at an irradiation dose of 500 mJ/cm².

62. The composition of claim 51, wherein said epoxy compound has a number average molecular weight of 1,000-20,000.

63. The composition of claim 51, wherein said epoxy compound has a molecular weight of less than about 1,000.

64. The composition of claim 63, wherein said epoxy compound is an alicyclic epoxy compound.

65. A composition comprising:

(i) an oxetane selected from the group consisting of 3-ethyl-3-hydroxymethyloxetane, 3-(meth)-allyloxymethyl-3-ethyloxetane, (3-ethyl-3-oxetanylmethoxy)methylbenzene, 4-fluoro-[1-(3-ethyl-3-oxetanylmethoxy)methyl]benzene, 4-methoxy-[1-(3-ethyl-3-oxetanylmethoxy)methyl]-benzene, [1-(3-ethyl-3-oxetanylmethoxy)ethyl]phenyl ether, isobutoxymethyl(3-ethyl-3-oxetanylmethyl) ether, isobornyloxyethyl(3-ethyl-3-oxetanylmethyl) ether, isobornyl(3-ethyl-3-oxetanylmethyl) ether, 2-ethylhexyl(3-ethyl-3-oxetanylmethyl) ether, ethyldiethylene glycol (3-ethyl-3-oxetanylmethyl) ether, dicyclopentadiene (3-ethyl-3-oxetanylmethyl) ether, dicyclopentenyl(3-ethyl-3-oxetanylmethyl) ether, tetrahydrofurfuryl(3-ethyl-3-oxetanylmethyl) ether, tetrabromophenyl(3-ethyl-3-oxetanylmethyl) ether, 2-tetrabromophenoxyethyl(3-ethyl-3-oxetanylmethyl) ether, tribromophenyl(3-ethyl-3-oxetanylmethyl) ether, 2-tribromophenoxyethyl(3-ethyl-3-oxetanylmethyl) ether, 2-hydroxyethyl(3-ethyl-3-oxetanylmethyl) ether, 2-hydroxypropyl(3-ethyl-3-oxetanylmethyl) ether, butoxyethyl (3-ethyl-3-oxetanylmethyl) ether, pentachlorophenyl(3-ethyl-3-oxetanylmethyl) ether, pentabromophenyl(3-ethyl-3-oxetanylmethyl) ether, bornyl(3-ethyl-3-

oxetanylmethyl) ether, 3,7-bis(3-oxetanyl)-5-oxa-nonane, 3,3'-(1,3-(2-methylenyl)propanediylbis-(oxymethylene))-bis-(3-ethyloxetane), 1,4-bis[(3-ethyl-3-oxetanylmethoxy)methyl]benzene, 1,2-bis[(3-ethyl-3-oxetanylmethoxy)methyl]ethane, 1,3-bis[(3-ethyl-3-oxetanylmethoxy)methyl]propane, ethylene glycol bis(3-ethyl-3-oxetanylmethyl) ether, dicyclopentenylbis(3-ethyl-3-oxetanylmethyl) ether, triethylene glycol bis(3-ethyl-3-oxetanylmethyl) ether, tetraethylene glycol bis(3-ethyl-3-oxetanylmethyl) ether, tricyclodecanediyl dimethylene bis(3-ethyl-3-oxetanylmethyl) ether, trimethylolpropane tris(3-ethyl-3-oxetanylmethyl) ether, 1,4-bis(3-ethyl-3-oxetanylmethyl)butane, 1,6-bis(3-ethyl-3-oxetanylmethoxy)hexane, pentaerythritol tris(3-ethyl-3-oxetanylmethyl) ether, pentaerythritol tetrakis(3-ethyl-3-oxetanylmethyl) ether, polyethylene glycol bis(3-ethyl-3-oxetanylmethyl) ether, dipentaerythritol hexakis(3-ethyl-3-oxetanylmethyl) ether, dipentaerythritol pentakis(3-ethyl-3-oxetanylmethyl) ether, dipentaerythritol tetrakis(3-ethyl-3-oxetanylmethyl) ether, caprolactone modified dipentaerythritol hexakis(3-ethyl-3-oxetanylmethyl) ether, caprolactone modified dipentaerythritol pentakis(3-ethyl-3-oxetanylmethyl) ether, ditrimethylolpropane tetrakis(3-ethyl-3-oxetanylmethyl) ether, EO modified bisphenol A bis(3-ethyl-3-oxetanylmethyl) ether, PO modified bisphenol A bis(3-ethyl-3-oxetanylmethyl) ether, EO modified hydrogenated bisphenol A bis(3-ethyl-3-oxetanylmethyl) ether, PO modified hydrogenated bis(3-ethyl-3-oxetanylmethyl) ether, and EO modified bisphenol F bis(3-ethyl-3-oxetanylmethyl) ether;

(ii) an epoxy compound;

(iii) a cationic photoinitiator; and

(iv) a polyfunctional monomer selected from the group consisting of penta(meth)acrylates and hexa(meth)acrylates.